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Rule-based and Physics-based Weather Effects and Impacts for AWARES

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Objective



Continue the current implementation of weather effects in the AWARS model using methodologies that improve the estimation of weather impacts in the target acquisition algorithms without increasing AWARS run time

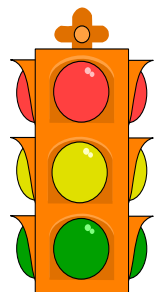


Approach



- **Two complementary approaches are being examined**

1) Implementation of systems operation rules using the library from the Integrated Weather Effects Decision Aid (IWEDA)

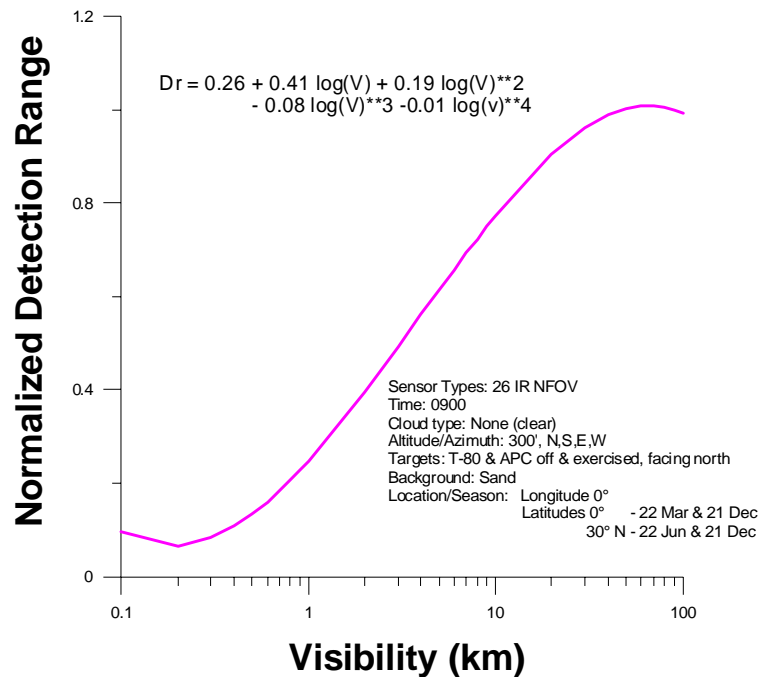


- **Unfavorable:** Operations Prohibited
- **Marginal:** Operational Capability Degraded
- **Favorable:** No Operational Restrictions

Any occurrence of visibility < 2.9 miles reduces the range and reflectiveness and makes lasing the target difficult.



2) Implementation of parametric curves for acquisition ranges using the Target Acquisition Weapons Software (TAWS)



- Detection ranges from TAWS under varying visibilities have been normalized, curve fit and implemented in AWARS
- Direct replacement for target acquisition probability look-up tables



Scenario Conditions

Locale

- **0° Longitude (Prime Meridian)**
- **0°, 30° N Latitudes**

Season

- **Equator: Equinox (22 Mar), Solstice (21 Dec)**
- **30° N: Summer (22 Jun), Winter (21 Dec)**

Sensor/Target

- **26 IR sensors**
- **Targets**
 - **T72, APC**
 - **Off & Exercised**
- **Background: Desert Sand**

LOS/Met

- **LOS Altitude/Azimuth: 300 ft / N, E, S, W**
- **Met Visibility: 0.1, 1, 10, 100 km**
- **Haze Aerosols: Rural, Advection Fog**
- **Cloud Cover: Ac/As; Clear, Overcast**

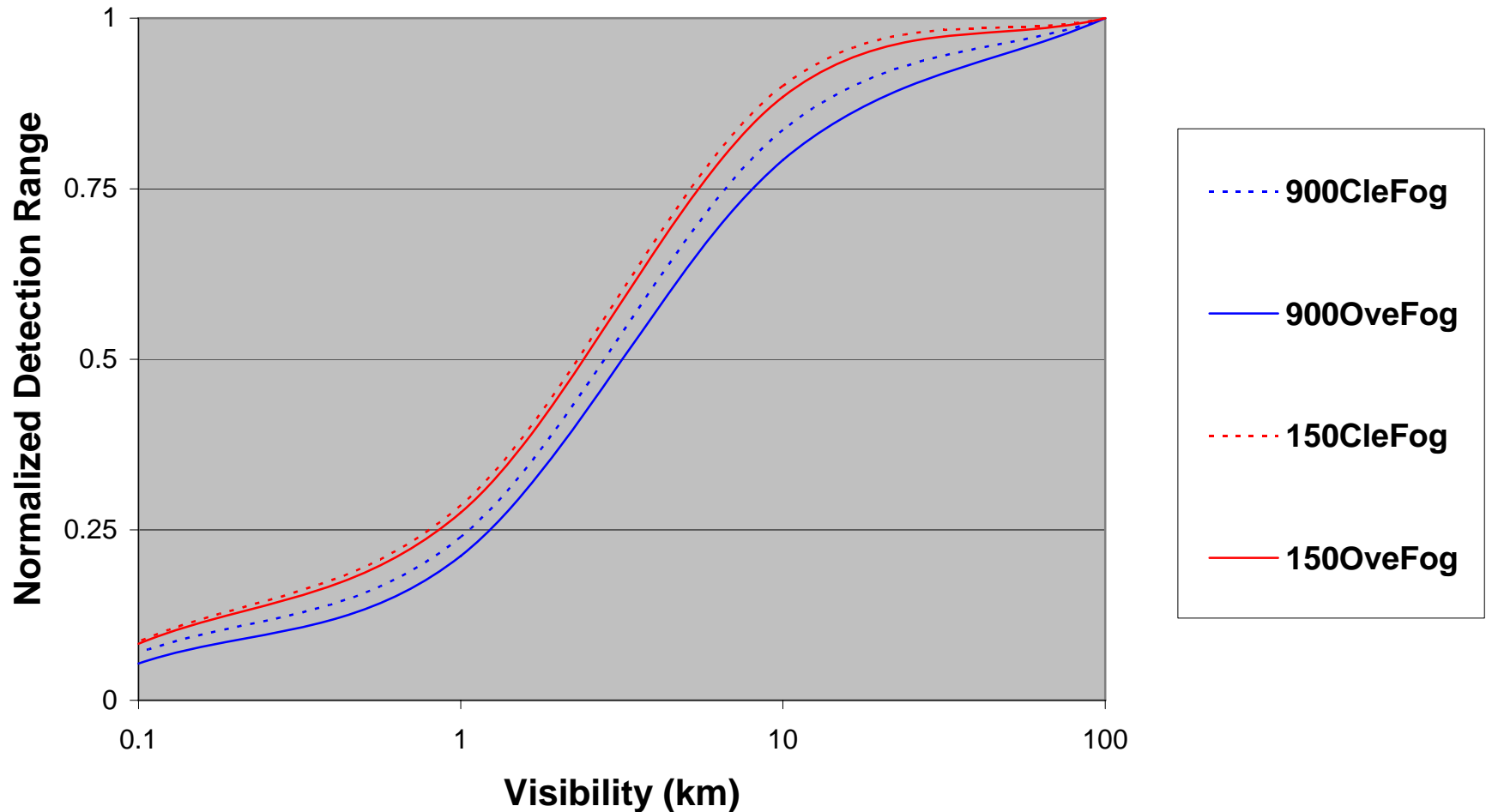


Averages over:

Sensor, season, azimuth, type, state and location



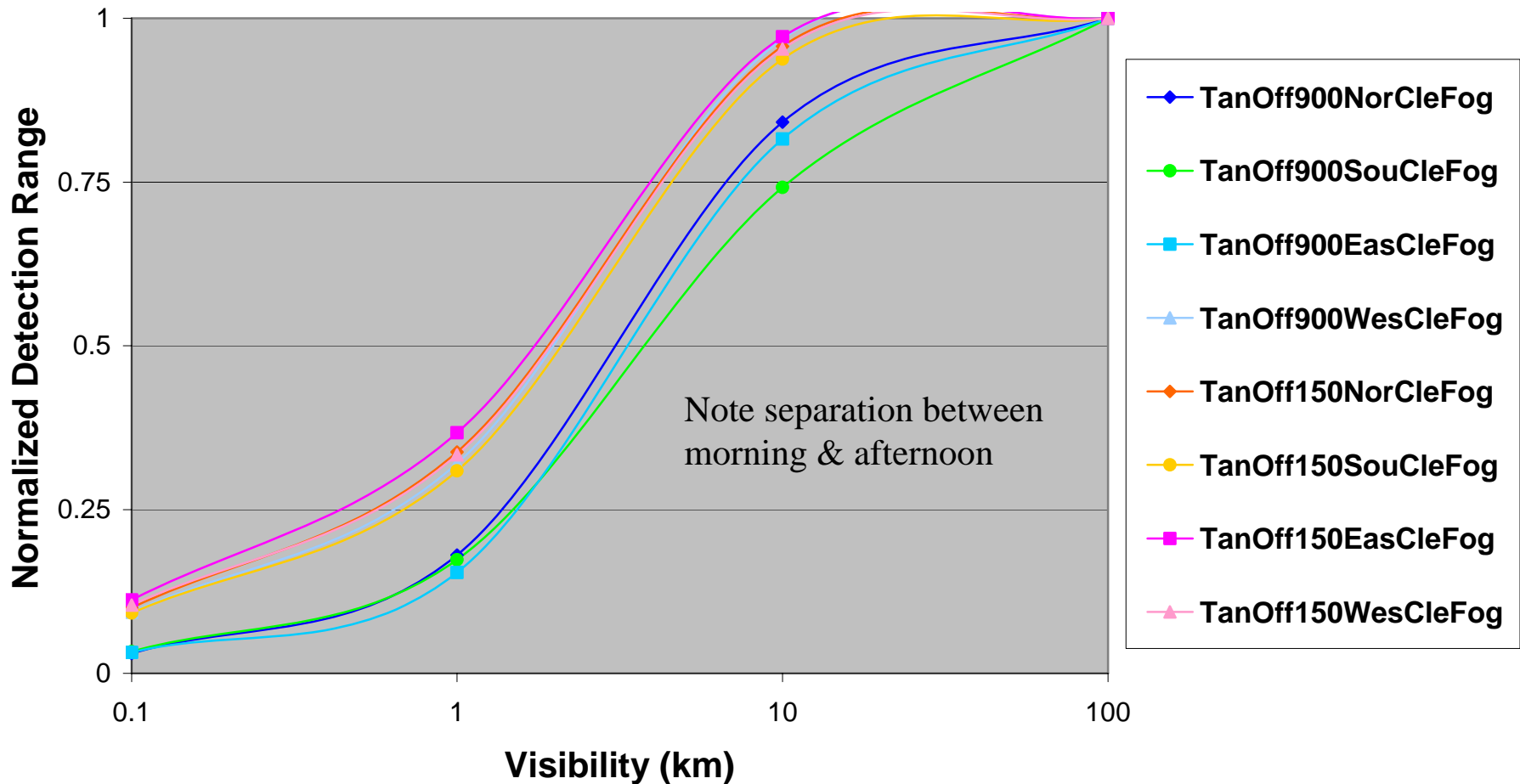
NFOV, Fog
 $f(\text{TOD, Cloud Cover})$





Average over: Sensors, seasons and locations

NFOV, Fog, **Off** Tank under cloudless skies
 $f(\text{TOD}, \text{Azimuth})$

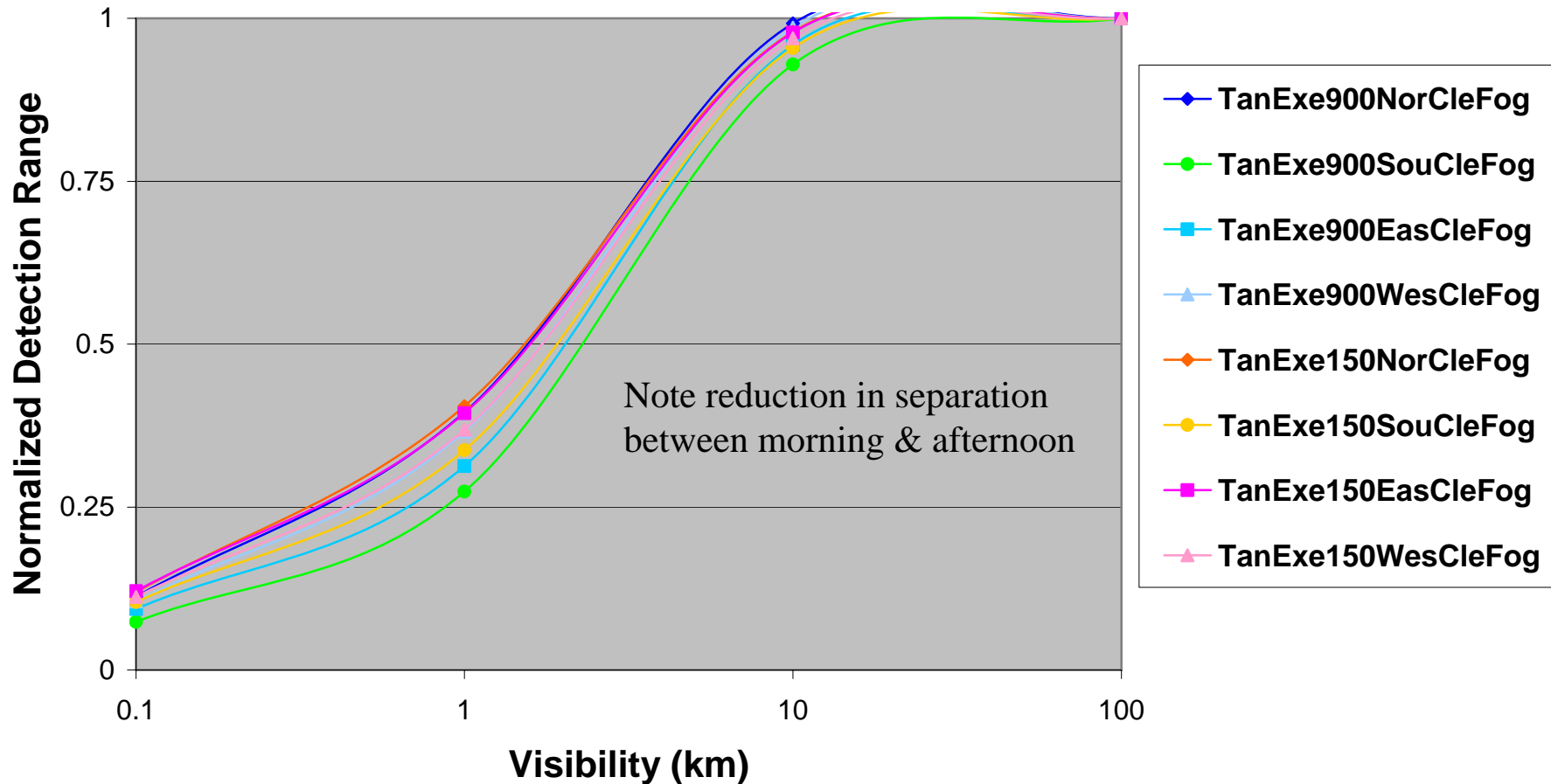




Averages over: Sensor, season & location



NFOV, Fog, **Exercised** Tank under cloudless skies $f(\text{TOD}, \text{Azimuth})$

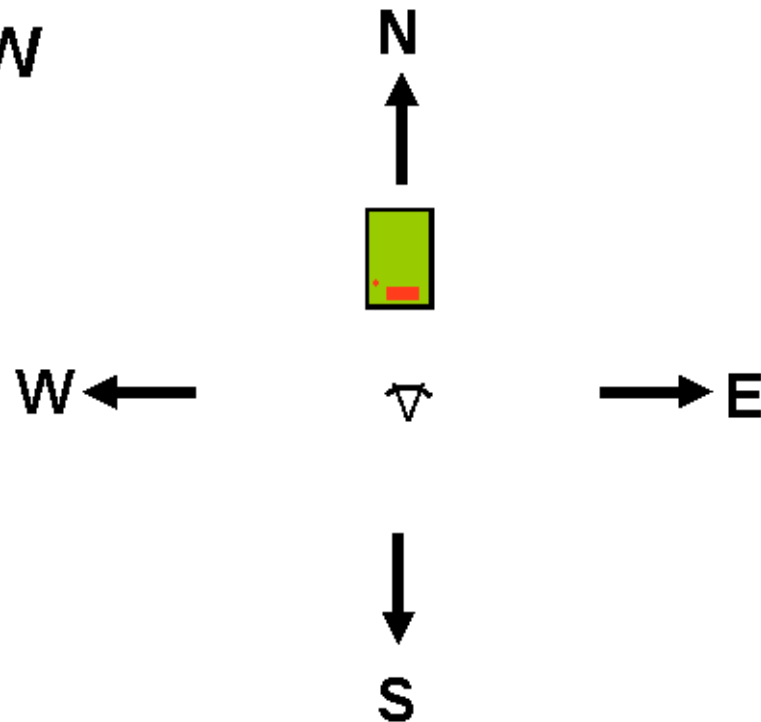




Sensor / Target Geometry



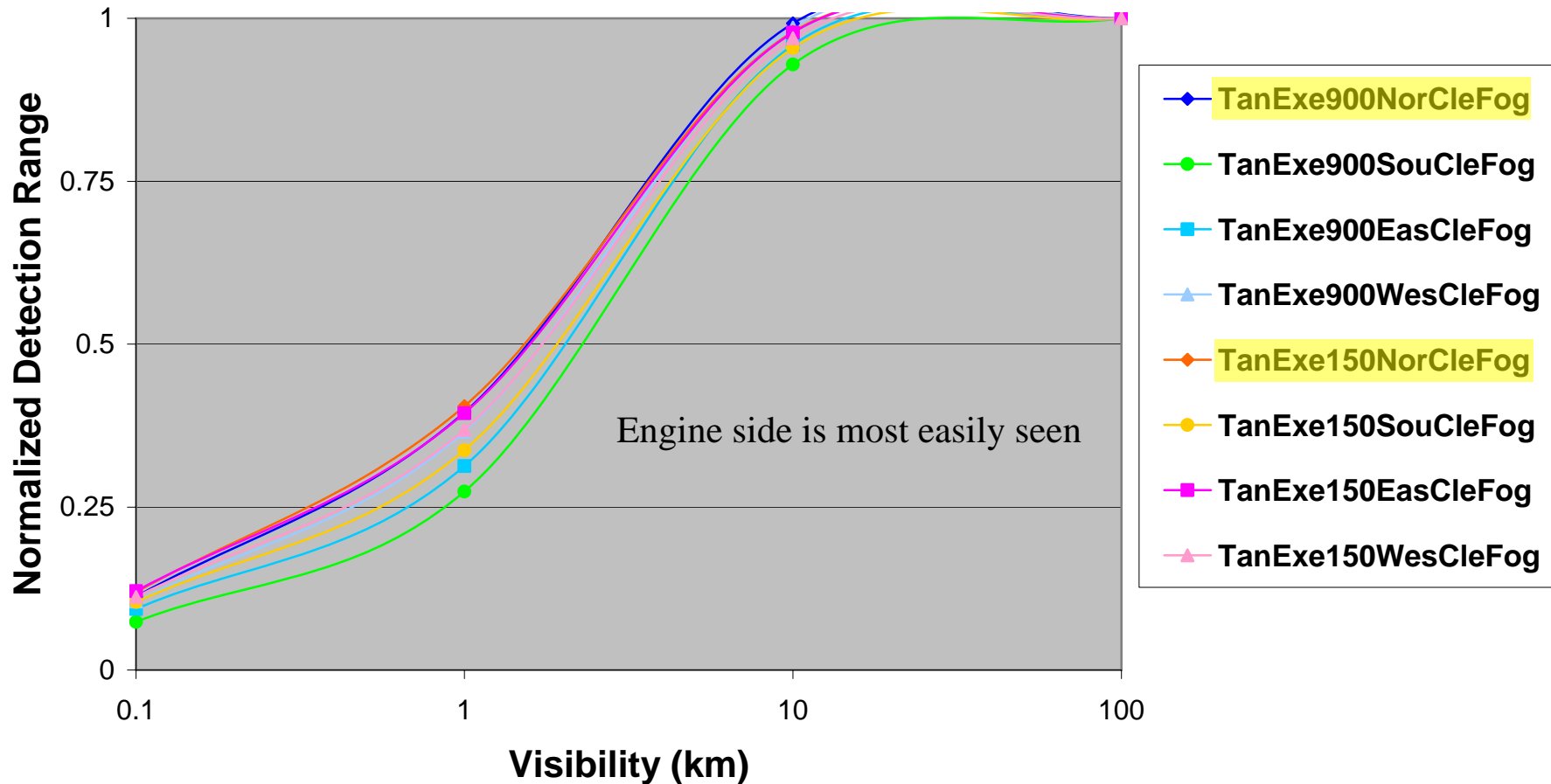
**NORTH
VIEW**





Averages over: Sensor, season & location

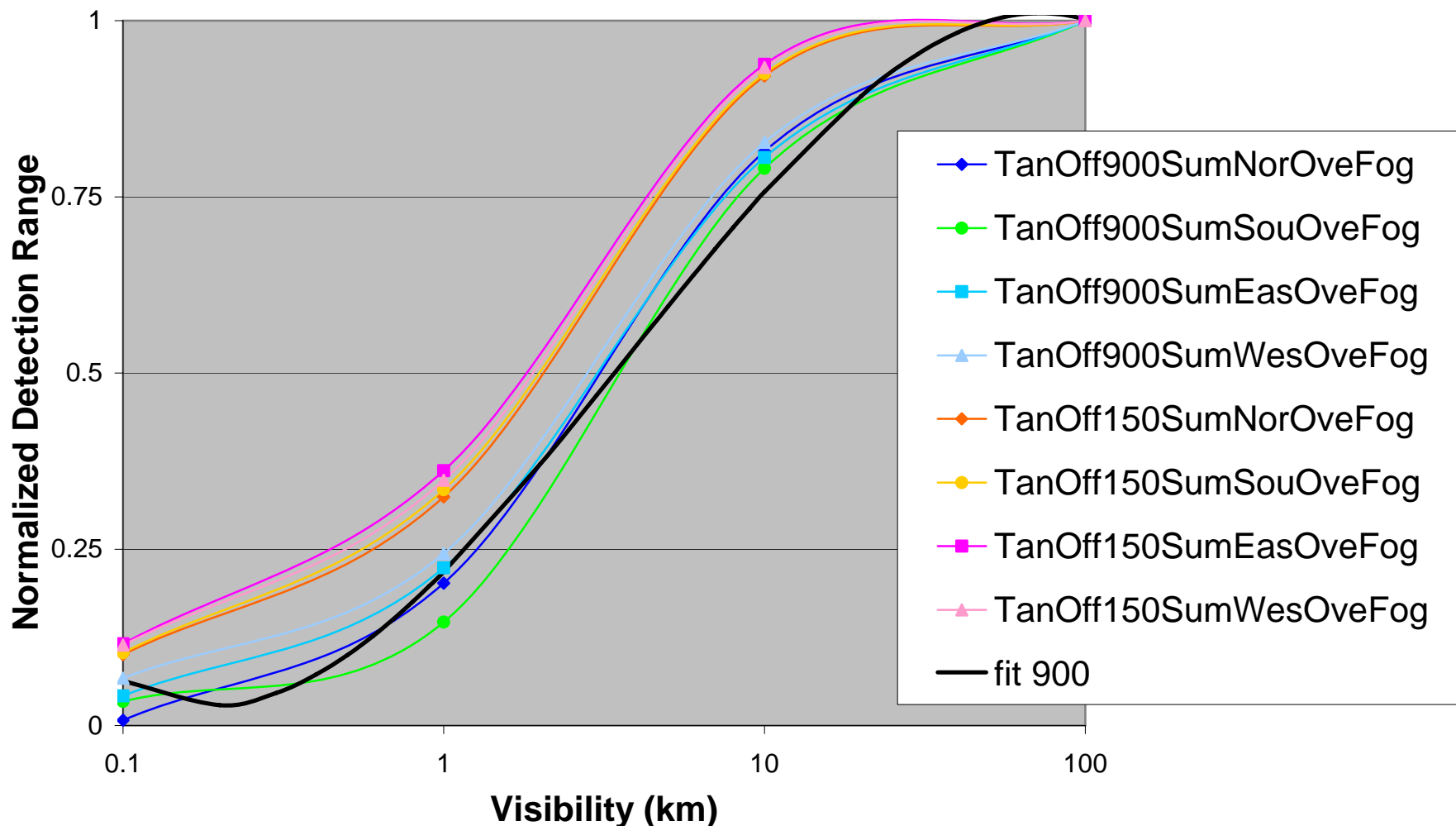
NFOV, Fog, **Exercised** Tank under cloudless skies
 $f(\text{TOD}, \text{Azimuth})$





Example Curve Fit

NFOV, Fog, Off Tank under overcast skies, Summer
f(TOD & Azimuth)
(averages over: sensors & locations)





AWARS IWEDA Modifications



- Addition of UAV/FWA and GMU rules and implementation is in progress
- Helo and UAV IWEDA mobility checks have been extended to include more parameters:
 - Surface Wind speed
 - Surface Visibility
 - Basic weather condition (heavy rain, snow, etc.)
 - Cloud Cover (significant for UAV missions)
 - Cloud Base Height (affects aerial platform vulnerability)
 - Surface Temperature (affects mission effectiveness)



AWARS DF Sensor Modifications



- New sensor curve fits
- Revised maximum sensor detection ranges
- Revised parametric averaging
 - Less aggregation of curve fits
 - Maximum detection ranges not aggregated



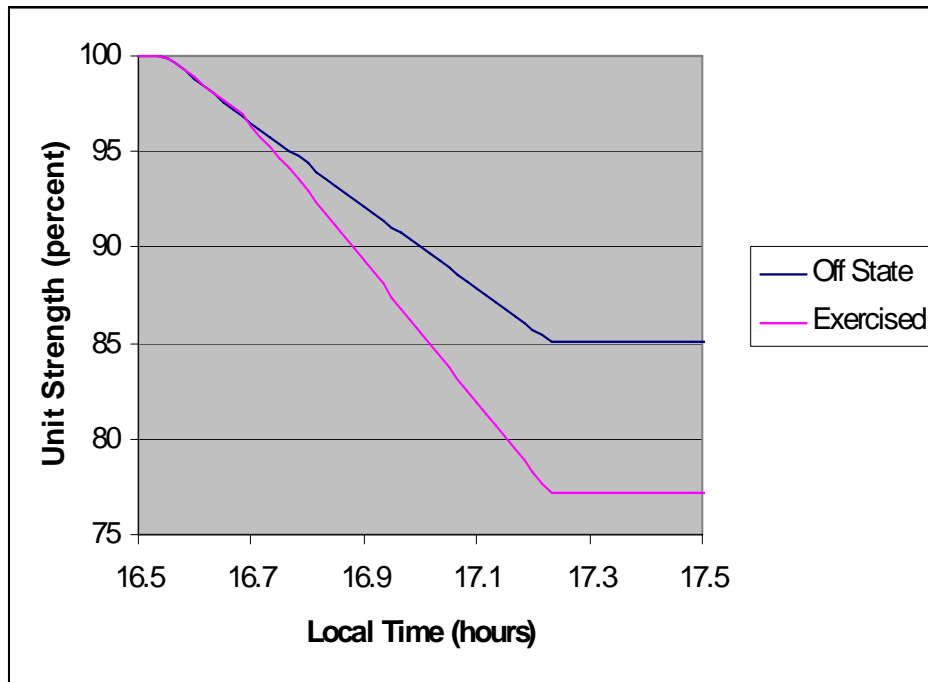
AWARS ARL Test Scenario

Target State Effects

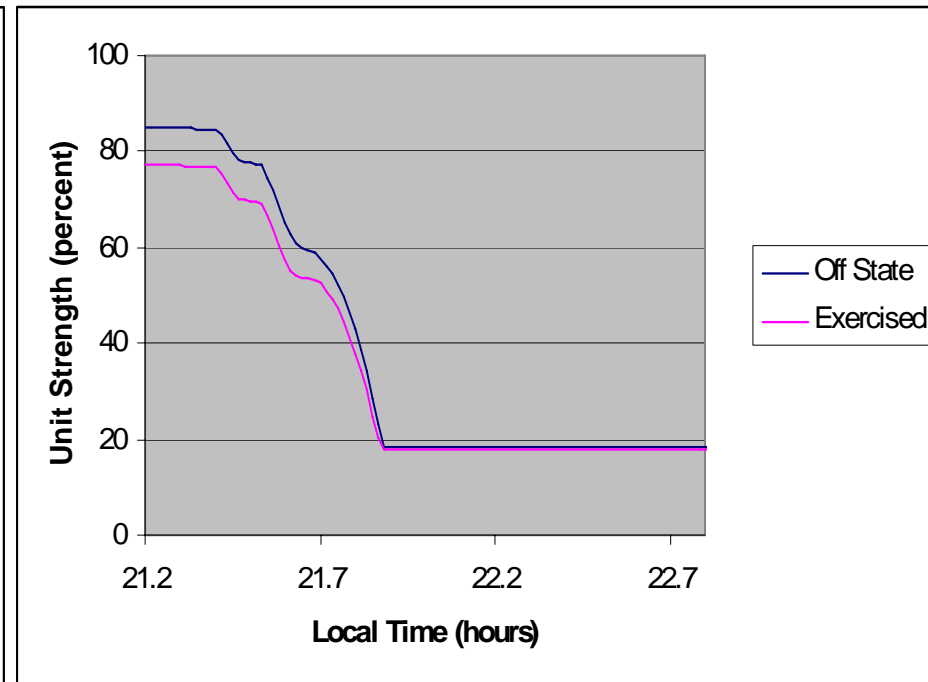


Defending Red (R2110MX) Unit, 0.5 km Met Visibility, Fog

Under attack by Blue Helos



Under attack by Blue Ground Units





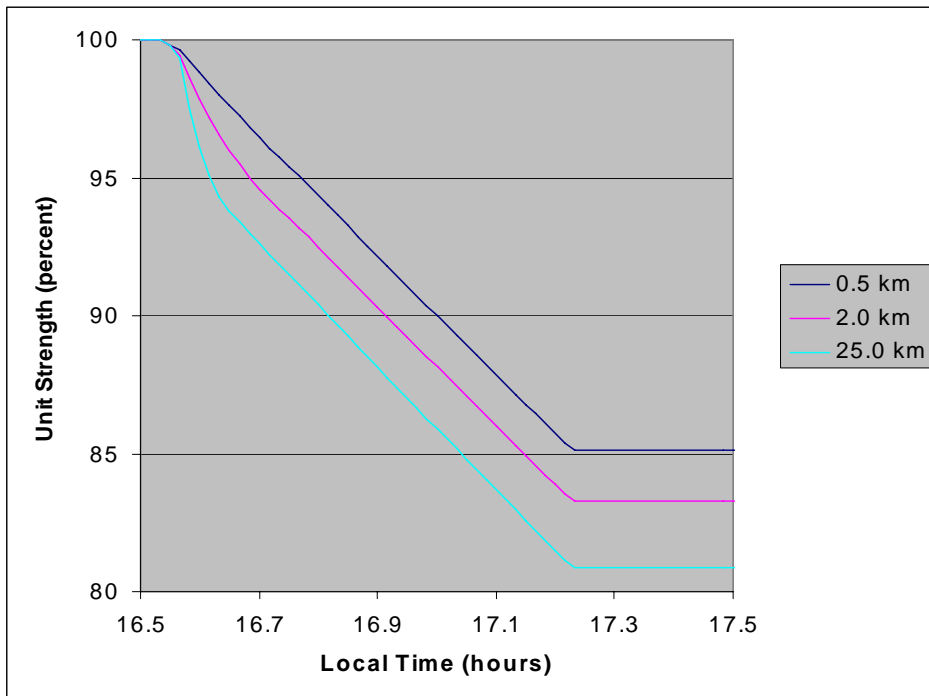
AWARS ARL Test Scenario

Met Visibility Effects

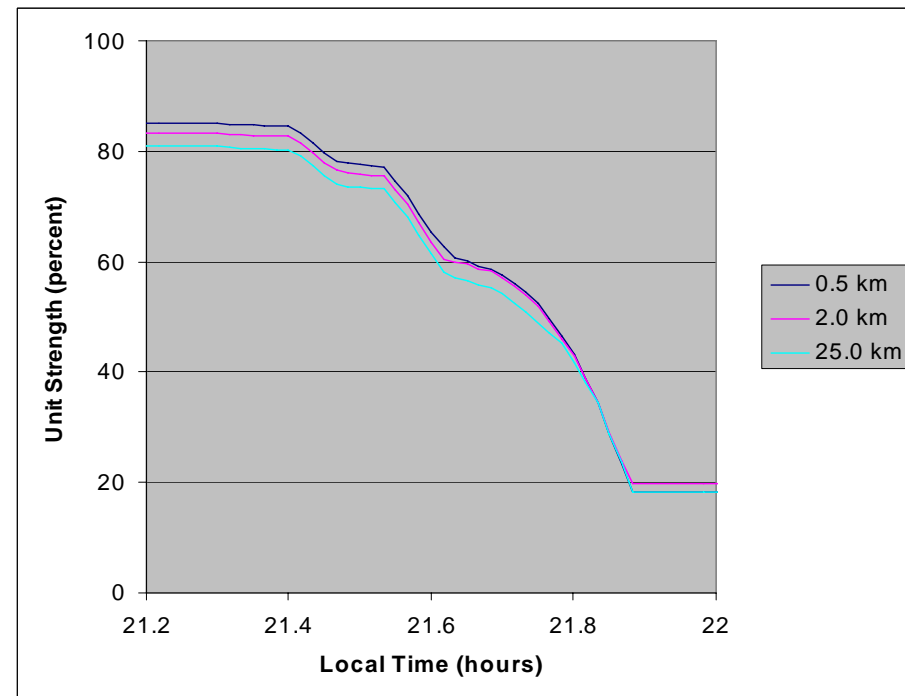


Defending Red (R2110MX) Unit, Off Target State, Fog

Under attack by Blue Helos



Under attack by Blue Ground Units





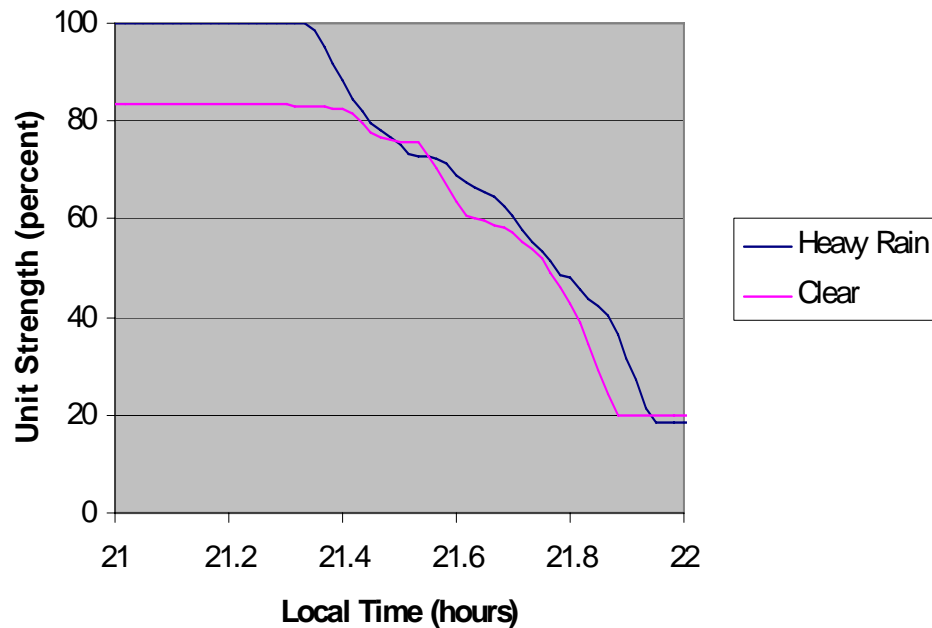
AWARS ARL Test Scenario

Basic Weather Condition Effects

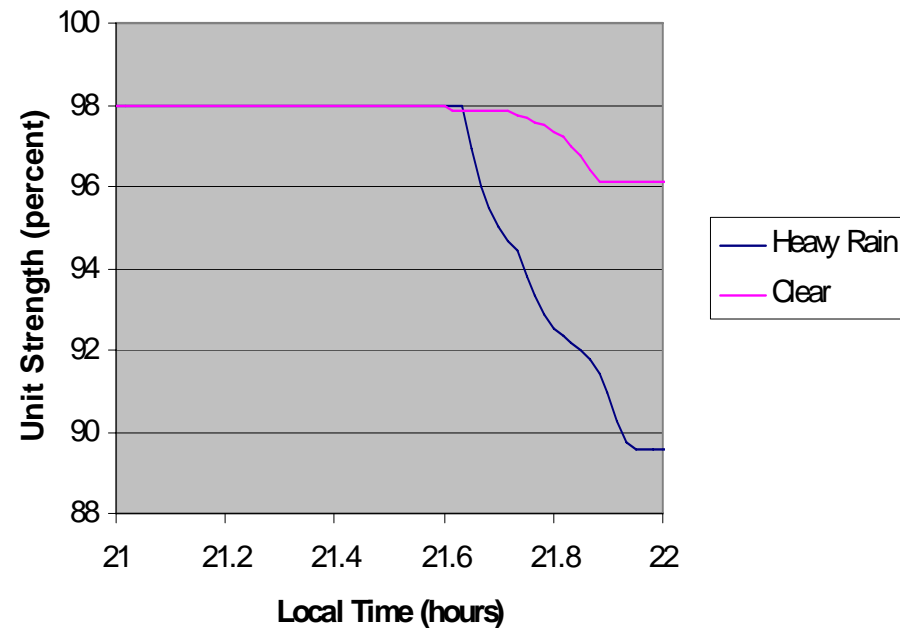


Blue Attack Helos Grounded by Heavy Rain, Off Target State, Fog, 2 km Met Visibility

Red (R2110MX) Defending Unit



Blue (B2110MX) Attacking Unit





Weather Database



Each Terrain Cell within Weather Effect Area

- **Basic Condition**
 - Clear, fog/heavy fog, rain/heavy rain, snow/heavy snow
- **Multiple entries by elevation**
 - Temperature
 - Humidity
 - Cloud coverage
 - DF acquisition & visibility calculations
 - Wind
 - Velocity
 - Direction
 - Speed
 - Used for Chemical/Smoke Transport & Diffusion
 - Sky Condition based on cloud cover
 - Clear, overcast, or heavy overcast



Future Work



Conceptual Schema

dashed: do once

solid: as called

